CONSTRUCTIVE BIOLOGY.

Some Neglected Factors in Evolution: an Essay in Constructive Biology. By H. M. Bernard. Edited by Matilda Bernard. Pp. xxi+489. (New York and London: G. P. Putnam's Sons, 1911.) Price 12*s.* 6*d.* net.

MANY who know the late Mr. Bernard's work in other fields—notably on Madreporarian corals, the Apodidæ, the Galeodidæ, and the retina—will be interested in this essay in constructive biology. Mr. Bernard was marked by a resolute independence of thought, and this quality, strengthened by his mathematical and philosophical training, is conspicuous in the book before us, a posthumous work, very carefully edited.

The first part of the volume is an exposition of the protomitomic theory, according to which what are called "cells" are merely form-features of some deeper underlying texture, namely, a fundamental linin-chromatin network. In the retina of vertebrates the author found a continuous network with the nuclei at the nodes. He called this fundamental reticulum in living substance, "the protomitomic network." "The connecting filaments were seen to be continuations of the filaments within the nuclei, so that the latter appeared to be merely special tangles of the filamentous network." In some tissues a large amount of cytoplasmic matter is required for their activities, and this tends to obscure the essential reticular structure; in other tissues the filaments are the most obvious structural elements. According to Mr. Bernard's view, which is expounded in a temperate, scholarly, and ingenious argument, the biological unit—both morphological and physiological—is not the cell, but a node in the reticular linin-chromatin system, a stellate linin-chromatin mass from which filaments radiate. By concentration of chromidia (*i.e.* minute chromatin particles which occur in the nodes of the linin network), rearrangement of filaments, and progressive centripetal differentiation, and the like, the first cells may have arisen. They are like enlarged editions of the chromidial units, capable of a larger "life."

This is not the sort of theory that can be called right or wrong; the question is whether it is useful in the interpretation of cellular structure and function. In a series of chapters the main conception—of a continuous filamentous system with nuclei distributed as centres of functional activity—is cleverly used as a key, not only in regard to structural details of epidermis, nervous system, sense organs, and the like, but also in regard to growth, cell-division, and even heredity. We come at length to the idea that organisms differ from one another in the pattern of their protomitomic networks, which is like the morphological side of Haeckel's idea that organisms differ from one another in the rhythm of their minutest protoplasmic particles or plastidules. It is indeed a fundamental biological conception that an organism is an individualised persistence of a specific activity inseparably associated with a specific structure.

In many of the cells that we are in the habit of looking at we are bound to confess that we cannot see anything of the protomitomic system, and the descriptions given by some of the most expert cytologists are not in favour of the author's view, which is essential to his whole theory, that the filaments of the nuclear network are *continuous* with the network of the cell-body. The suggestion is made that the use of osmic acid is to blame for the modern denial of the unity of the reticulum. Apart from the idea of continuity, it is possible to find in many recent researches some corroboration of the author's emphasis on the extra-nuclear chromatin. We think, for instance, of the modern insistence, due very largely to Richard Hertwig, on the importance of the chromidial (*i.e.* extra-nuclear chromatin) apparatus in the cytoplasm. Or we recall the "plastosomes" of Meves, elementary structures in the cytoplasm, which are regarded as the foundations or primordia of ontogenetic differentiations.

The second part of the book contains the author's theory of evolution. It is very interesting, characteristically fresh and independent, but within the space at our disposal we cannot do more than allude to three of its outstanding features. The first is the idea of a cosmic rhythm, which is akin to a suggestion that Herbert Spencer made, but left undeveloped, that "life on the earth has not progressed uniformly, but in immense undulations." As Mr. Bernard expressed it: "Organic life is seen advancing out of the dim past upon a series of waves"; period succeeds period, each with a higher unit—"each evolutionary period can be described by the same formula, the processes in all cases being essentially the same, although the factors involved become increasingly complex." The first period is that of the chromidial unit, the second that of the cell unit, the third that of the gastræal unit, the fourth that of the annelidan unit, the fifth that of man. One must remember, of course, that even so far back as the Cambrian life had got a long way past the simpler expressions of the annelidan unit.

The second outstanding feature is the author's conviction that the Darwinian theory accounts for detailed adaptation rather than for great advances in *type*, and that the production of new types is describable as a kind of colony-formation. This was the lesson that the author learned from his thirteen years of work on corals. "The physical force of life" has had periodic outbursts of growth leading to the production of homogeneous aggregates, to repeated colony-formation, to "raisings of the level of life," to "altogether new organisation." Many naturalists have pondered over colony-formation, and we are not prepared to accept the statement on p. 299, that "colonies are regarded by them merely as accidental knots in the evolutionary chain, of no value to the chain." We feel sure, for instance, that the veteran zoologist of Jena will heartily agree with the thesis which his esteemed student has developed in chapter xvii., that colony-formation is an essential factor in evolution. What we miss, however, is a recognition of alternating periods of aggregation and integration.

The third distinctive feature in the etiology of this book is the recognition of "a psychic element in life." While "the assumption of a special 'vital force' is a

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knot gratuitously tied in the tangled skein of physical and psychical phenomena," and while the author "would deprecate the assumption that the psyche has mixed, in any way, as an integral factor in the machinery of the building processes of the forms of life, or in their daily workings as intricate mechanisms," yet he believes that the psyche has been able to exert an influence on the working by either delaying or hastening it. In this the psyche is like Driesch's "Entelechy," which punctuates the transformations of energy within the body.

THE SENSIBILITY OF THE ALIMENTARY CANAL.

The Goulstonian Lectures on the Sensibility of the Alimentary Canal. Delivered at the Royal College of Physicians on March 14, 16, *and* 21, 1911. By Dr. Arthur F. Hertz. Pp. v+80. (London: Henry Frowde and Hodder and Stoughton, 1911.) Price 5*s*. net.

THE lectureship which was founded by the late Dr. Goulston is annually awarded to one of the newly elected fellows of the Royal College of Physicians, and so forms a channel by means of which a junior member of the medical profession may make what has often proved to be the first of a valuable series of additions to physiological and pathological progress. Dr. Hertz, however, to whom the honour was awarded this year, is already well known to his medical brethren, and has published many papers on various subjects, as well as a book on constipation. It is to him and his colleagues at Guy's Hospital that we owe the work by means of which the X-ray method has been rendered an aid in medical, as it had been previously shown to be in surgical, cases, and during recent months allusions have been made in these columns to the value of such research in elucidating the disorders of the alimentary canal.

In the present volume, in which Dr. Hertz republishes his lectures, he has, however, struck a new note, and deals with the sensations arising from this part of the body.

The martyr to dyspepsia needs no reminding how insistent such sensations may be. The man in perfect health, however, is scarcely cognisant of the existence of his internal organs. In pre-anæsthetic days, surgeons discovered that the majority of the internal structures of the body are insensitive to touch; they can be handled, and even cut or burnt without causing any sensations. Dr. Hertz not only confirms this by his careful experimental and clinical observations, but has further shown that the alimentary canal is, with the exception of the œsophagus and the anal canal, also insensitive to sensations of heat and cold. Contact with alcohol, however, applied to any part gives rise to a subjective sensation of warmth.

But, as already suggested in the mention of the dyspeptic, pain is experienced; this sensation, which is probably the most primitive of the senses, as it is so important for protective purposes in the struggle for existence can be elicited, but its only cause is tension or stretching, which in a milder degree is also the cause of the sensation of fulness. If disease spreads to, or the tension is exerted on, peritoneal structures, the pain may become excruciating. This sensibility varies in different people, and is most marked in those with an irritable nervous system, as in neurasthenia, hypochondriasis, and anæmia. But when visceral pain or discomfort is present, all people are alike in their inability to localise it accurately. It is then that the so-called "referred pains" come to the assistance of the physician. By this one means that areas of skin and subjacent muscle related to the same spinal segments that govern the viscera, are the seat of discomfort, pain, and even of tenderness. This aspect of the subject has been taken up especially by Dr. Henry Head, and it is quite possible to localise an internal disorder by a study of the referred pain. The painful, tender patch may not always be in the immediate vicinity of the affected organ, for in growth the skin area, and the internal viscus which send their messages to the same segment of the spinal cord may become widely separated; for instance, the association of liver trouble and shoulder pain is familiar even to the non-medical reader.

The alimentary canal, though destitute of any true tactile sense, is endowed with certain sensations peculiar to itself, namely, hunger and thirst. These two sensations do not run quite on all fours with each other, and of them Dr. Hertz refers to hunger only. This consists not only in a general sensation of malaise, but a local sense of abdominal emptiness. Dr. Hertz believes that the latter is produced by the motor activity of the stomach and intestines during fasting; and this affects consciousness partly because the action is excessive, and partly because the central nervous system is over-excitable in this condition.

The brochure of which we have attempted this brief and imperfect summary will amply repay careful perusal, and hearty congratulations are due to its author, not only for his accurate and well-devised experimental work and observations, but also for the lucid and interesting way in which he has presented them.

W. D. H.

A NEW PRIMER OF PSYCHOLOGY.

The Essentials of Psychology. By Prof. W. B. Pillsbury. Pp. xi+362. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s*. 6*d*. net.

THE task of writing a good elementary text-book on any science is notoriously arduous, and this is especially the case with so difficult a subject as that of psychology. The ideal writer of such a book would be one whose power of taking a broad and unbiassed view of his subject was guaranteed by a thoroughly sound previous training in mathematics, physiology, and philosophy (metaphysics, logic, ethics, &c.), every one of which sciences is absolutely essential to a competent knowledge of psychology in its full extent at the present day. A writer falling short of this ideal is likely to betray the fact by an unevenness, more or less pronounced, in his treatment of different parts

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